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GB 1053704 A **US 5630411 A**

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(54) Abstract Title: **Expiratory valve unit**

(57) An expiratory valve unit 10 comprises a body having an outlet 16 and a rotary closure member 20 normally biased against a valve seat 18 to close the outlet 16 and rotatable relative to the body under pressure from user exhalate to open the outlet 16. The body may have a plurality of outlets 16 and the closure member may have a plurality of blades 22. The blades 22 may be helical and the closure member 20 may be biased against the valve seat 18 by a spring 26. Also disclosed is a kit of parts and a method for connecting breathing apparatus to the face of a wearer wherein a unit has a flexible body for forming a seal with the wearers face.

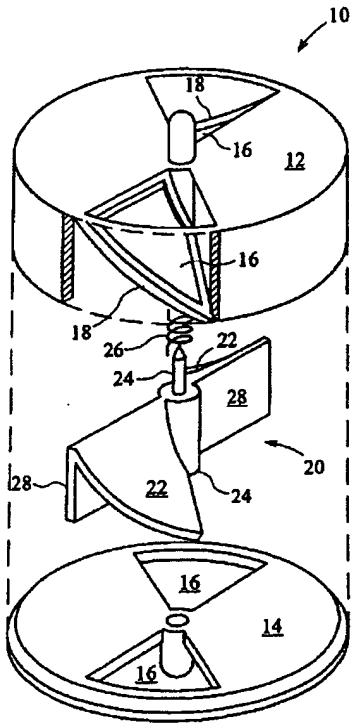

Fig. 1

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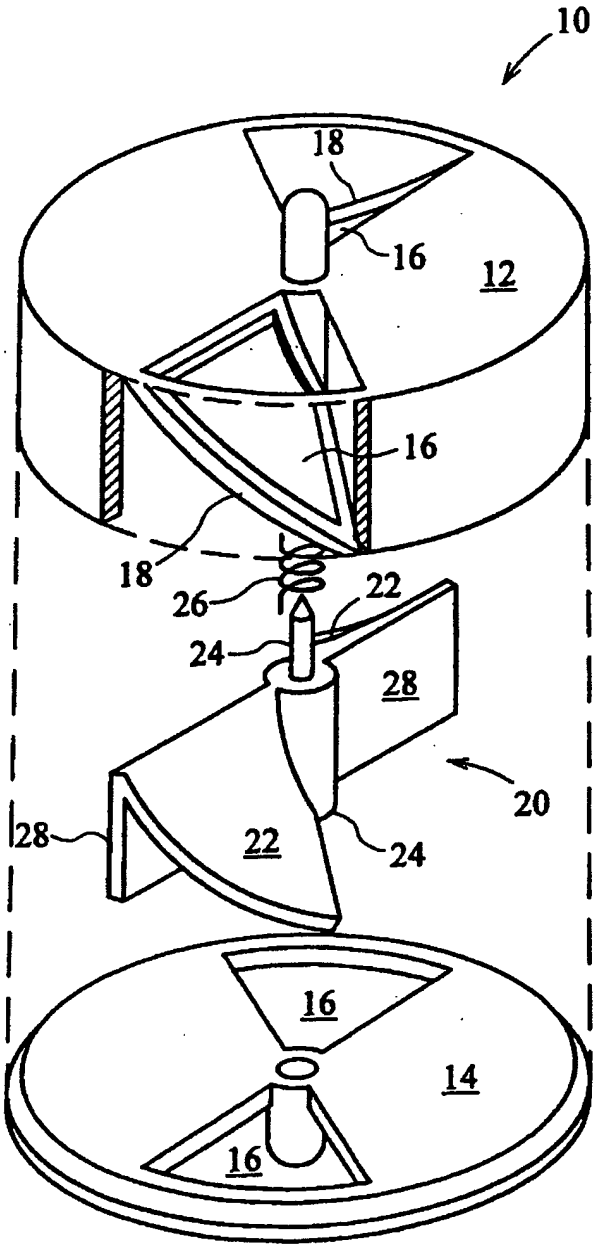

Fig. 1

EXPIRATORY VALVE UNIT

The present invention relates to an expiratory valve unit, and to a respirator incorporating the same. The invention also relates to a kit of parts for fitting breathing apparatus to the face of a wearer.

In modern combat aircraft breathing gas is supplied to a face mask worn by the airman. The breathing gas is pressurised and is drawn into the mask through a non-return, inspiratory valve therein as the airman inhales. When the airman exhales an expiratory valve allows the exhalate to be vented to the atmosphere. It is essential that this second valve only opens when the airman exhales. However, conventional expiratory valves are not suitable for service in high agility aircraft, because during manoeuvres which generate high G forces the valves are either forced open, allowing breathing gas to vent directly from the supply to the atmosphere, or closed, making it impossible for the airman to exhale. For example, a known type of poppet valve has a spring loaded disc moving on the axis of a cylinder and is inherently sensitive to any acceleration along that axis.

It is an aim of at least the preferred embodiment of the present invention to solve these and other problems.

In one aspect the present invention provides an expiratory valve unit comprising a body having an outlet, and a rotary closure member mounted for rotation about an axis passing through the centre of gravity of the closure member, the closure member being normally biassed against a valve seat to close the outlet and rotatable relative to said body when under pressure from user exhalate to open the outlet. This can provide a balanced system that can deliver use substantially independent from any G forces acting thereon.

In another aspect the present invention provides an expiratory valve unit comprising a body having a plurality of outlets, and a rotary closure member having a plurality of blades, the closure member being normally biassed against a valve seat to close

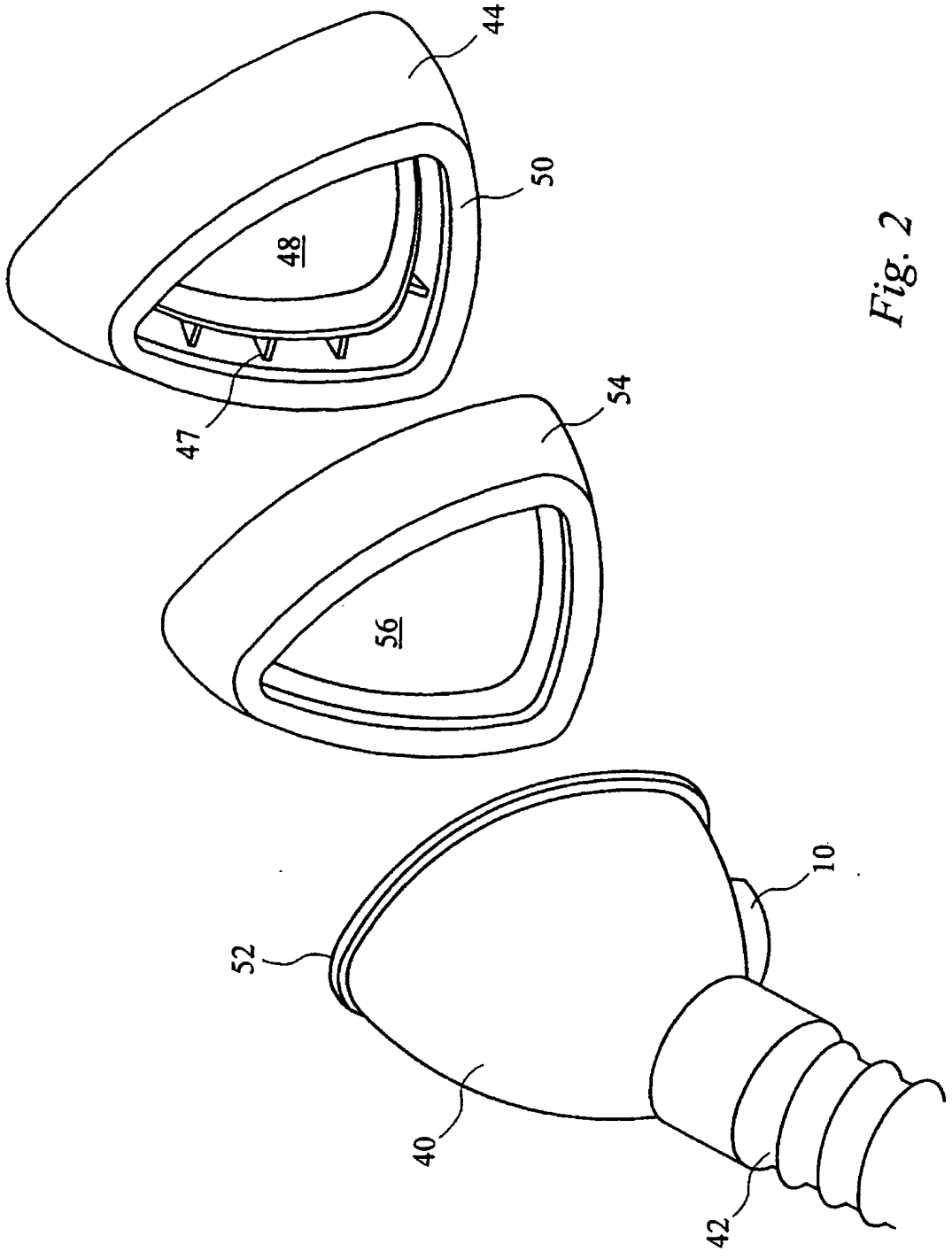

Fig. 2

the outlets and rotatable relative to said body when under pressure from user exhalate impinging the blades to open the outlets.

Preferably the blades are symmetrically disposed about the closure member. The or each blade is preferably helical.

The axis of rotation of the closure member preferably extends in the direction of exhalate flow through the or each outlet. Preferably, the axis of rotation of the closure member extends substantially parallel to the direction of exhalate flow through the or each outlet. Preferably the closure member comprises damping means extending radially thereof. Such damping means may comprises surfaces intersecting the axis of rotation of the closure member.

The invention extends to a respirator comprising a valve unit according to any preceding claim. Respirators for providing breathing gas to a crew member are typically designed to cover the wearer's nose and mouth, and include a rigid shell with fastenings to attach it to the wearer's head and into which passes a feed tube for the breathing gas. A flexible face seal, typically moulded from sheet rubber, is enclosed in the shell. The breathing apparatus, including the inspiratory and expiratory valves, together with a communications microphone, are housed in the flexible face seal.

Existing data about facial characteristics refers primarily to surface features and their dimensions. However, the tissues of the face have varying degrees of compliance, with the compliant areas being supported on a rigid but articulated infrastructure. Therefore, the size of the rubber seal must be sufficient to accommodate for such variations in the compliance of the facial tissues, as well as for variations in face shapes and sizes between crew members. However, increased use of such high density/low structural strength materials leads to an undesirable increase the weight of the mask.

It is another aim of the preferred embodiment of the present invention to solve these

and other problems.

In another aspect, the present invention provides a kit of parts for connecting breathing apparatus to the face of a wearer, the kit comprising a range of similar pre-formed units of varying shape and/or size for selective connection, according to the shape and/or size of the wearer's head, to a second unit housing said breathing apparatus, each pre-formed unit having a flexible body for forming a seal with a wearer's face.

By providing a range of pre-formed units in various sizes, the units can be readily selected to custom-fit the breathing apparatus to an individual airman. Optical scanning using a laser or the like can provide an accurate profile of the wearer's face to enable the most suitable pre-formed unit to be selected for use by that airman. This can enable a reduction in the amount of rubber material used, whilst still enabling an effective seal to be formed with the wearer's face during use. Replacement of the redundant rubber material with a lighter, more rigid material, such as plastics material, can allow for overall mask weight reduction as well as increasing the strength of the mask. Use of precision tooling can allow accurate control of component geometry so that the mass of the unit is minimised.

Each pre-formed unit preferably comprises means for preventing inversion of the sealing surface of the unit when under pressure. The means may be integral with the seal.

The kit preferably comprises a range of similar pre-formed rigid units of varying shape each for selectively connecting a respective first pre-formed unit to the second unit.

This aspect of the present invention also extends to a method of connecting breathing apparatus to the face of a wearer, comprising connecting to a unit housing said breathing apparatus a second unit having a flexible body for forming a seal with a wearer's face, the second unit having been selected from a range of similar units

of varying shape and/or size according to the shape and/or size of the wearer's face.

Preferred features of the present invention will now be described with reference to the accompanying drawings, in which:

Figure 1 illustrates an exploded view of an expiratory valve unit; and

Figure 2 illustrates an exploded view of a respirator.

With reference to Figure 1, an expiratory valve unit 10 comprises a body having upper 12 and lower 14 portions and a plurality of outlets 16 for user exhalate formed therein. In the illustrated embodiment, the body has two outlets 16, but additional outlets 16 may be provided. A valve seat 18 extends around each outlet 16 (a portion of the upper portion 14 is removed from Figure 1 for clarity purposes only). A rotary closure device 20 is mounted within the body for rotation relative thereto. The closure member 20 includes a plurality of helical blades 22, one for each outlet 16, and has an axis of rotation 24 lying substantially parallel to the direction of exhalate flow through the outlets 16. The closure device is normally biassed by a spring 26 so that the blades 22 are forced against the valve seats 18 to close the outlets 16. In use, exhalate pressure exerted on the blades 22 resolves into axial and rotary forces, causing the closure member 20 to rotate against the force of the spring and open the outlets 16 to enable the exhalate to pass to the atmosphere. When the user has stopped exhaling, the spring 26 urges the blades back against the valve seats, thus closing the outlets 16. Surfaces 28 of the closure member, whose planes intersect the axis of rotation 24, provide damping by entering close fitting pockets between the upper and lower portions of the body.

With reference to Figure 2, the expiratory valve unit 10 is housed in a rigid unit 40 of a respirator. Unit 40 houses all of the common elements of the respirator, such as the remainder of the breathing apparatus, including an inspiratory valve unit, and a communications microphone. The unit 40 is connected to a supply hose 42 for the supply of breathing gas to a wearer, such as an airman. The unit 40 is a

common element of the breathing mask, in that it is supplied in common to many airmen regardless of facial size and/or shape. The unit 40 is connected to a pre-formed unit 44 having a flexible body moulded from, for example, rubber material, for sealing to an airman's face. The inner surface of the body may be moulded with features 47 which prevent the reflex edge of the sealing surface of the unit from becoming inverted under pressure.

The pre-formed unit 44 is a sized component, which may also be shaped to suit differing racial characteristics, selected from a range of such units 44 according to the size and/or shape of the wearer's face. The units 40, 44 are assembled by threading the supply hose 42 though aperture 48 in the unit 44 and drawing the unit 44 around the unit 40 so that lip 50 of the unit 44 engages the raised edge 52 of the unit 40. A rigid clamping unit 54, which may be formed from moulded plastics material, is, like the unit 44, a sized component and selected from a range of similar units in accordance with the particular unit 44 chosen for the airman. The clamping unit 54 is assembled to the units 40, 44 by similarly threading the supply hose 42 through the aperture 56 and drawing the clamping unit 54 around unit 40 to engage the unit 44. The clamping unit 54 may be secured by a snap-fit or by any conventional fastening.

Each feature disclosed in the description, and/or the claims and drawings may be provided independently or in any appropriate combination. In particular a feature of a subsidiary claim may be incorporated in a claim from which it is not dependent.

CLAIMS

1. An expiratory valve unit comprising a body having an outlet, and a rotary closure member mounted for rotation about an axis passing through the centre of gravity of the closure member, the closure member being normally biassed against a valve seat to close the outlet and rotatable relative to said body when under pressure from user exhalate to open the outlet.

2. A valve unit according to Claim 1, the body having a plurality of outlets, the closure member having a plurality of blades and being rotatable relative to said body when under pressure from user exhalate impinging the blades to open the outlets.

3. An expiratory valve unit comprising a body having a plurality of outlets, and a rotary closure member having a plurality of blades, the closure member being normally biassed against a valve seat to close the outlets and rotatable relative to said body when under pressure from user exhalate impinging the blades to open the outlets.

4. A valve unit according to Claim 2 or 3, wherein the blades are symmetrically disposed about the closure member.

5. A valve unit according to any of Claims 2 to 4, wherein each blade is helical.

6. A valve unit according to any preceding claim, wherein the axis of rotation of the closure member extends in the direction of exhalate flow through the outlets.

7. A valve unit according to Claim 6, wherein the axis of rotation of the closure member extends substantially parallel to the direction of exhalate flow through the outlets.

8. A valve unit according to any preceding means, wherein the closure member

comprises damping means extending radially thereof.

9. A respirator comprising a valve unit according to any preceding claim.

10. A respirator according to Claim 9, comprising a first unit having a flexible body for forming a seal with a wearer's face, and, connected to the body, a second unit housing breathing apparatus including said valve unit.

11. A respirator according to Claim 10, wherein the first unit comprises means for preventing inversion of the sealing surface when under pressure.

12. A respirator according to Claim 11, wherein said means are integral with said seal.

13. A respirator according to any of Claims 10 to 12, comprising a rigid unit extending about the second unit for connecting the first unit to the second unit.

14. A kit of parts for connecting breathing apparatus to the face of a wearer, the kit comprising a range of similar pre-formed units of varying shape and/or size for selective connection, according to the shape and/or size of the wearer's head, to a second unit housing said breathing apparatus, each pre-formed unit having a flexible body for forming a seal with a wearer's face.

15. A kit of parts according to Claim 14, comprising a range of similar pre-formed rigid units of varying shape each for selectively connecting a respective first pre-formed unit to the second unit.

16. A method of connecting breathing apparatus to the face of a wearer, comprising connecting to a unit housing said breathing apparatus a second unit having a flexible body for forming a seal with a wearer's face, the second unit having been selected from a range of similar units of varying shape and/or size according to the shape and/or size of the wearer's face.

17. An expiratory valve substantially as herein described with reference to Figure 1 of the accompanying drawings.

18. A respirator substantially as herein described with reference to Figure 2 of the accompanying drawings.

INVESTOR IN PEOPLE

Application No: GB0311338.8 **Examiner:** Eleanor Wade

Claims searched: 1,2,4-13 **Date of search:** 23 March 2004

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular reference
A	-	GB 1053704 A Dragerwerk see esp figs 1-3
A	-	US 5630411 A Holscher see esp fig 5

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC[W] :

A5T; F2V

Worldwide search of patent documents classified in the following areas of the IPC[07]

A61M; A62B

The following online and other databases have been used in the preparation of this search report

EPODOC, JAPIO, WPI

DUSTPROOF MASK

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Applicant: SUESHIGE TATEYOSHI
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(IPC1-7): A62B17/04; A62B18/02
- european:
Application number: JP19800071206 19800526
Priority number(s): JP19800071206 19800526

Abstract not available for JP56166859

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